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Business Case for Energy Efficiency in Public Schools

The Public Schools market sector presents both significant opportunity for energy efficiency, but presents unique challenges based on campus configuration and governance.

A key challenge in public schools is to identify and engage the individual decision-makers and to align their personal interests with the implementation of energy efficiency improvements. They do not align spontaneously; schools are far from monolithic, and what may seem a logical argument for a school can have little resonance with the individuals who have to say "yes." The larger facilities can be approached individually, whereas the smaller schools have to be aggregated in sufficient number to justify the transaction costs of marketing and uncompensated engineering.

Although energy and water are not large budget items, the changes needed for efficiency improvements require many approvals all the way up to the Superintendent's office and sometimes the Board of Education. Thus aggregation of facilities and packaging of benefits for the many decision-makers have to be prepared with understanding of the variety of facilities and staffing.
Many differentiators that are important in other sectors are less so in public schools: varying access to capital, competition, tenancy and lease variations, proprietary issues, regulatory constraints, etc. play a far less important part in deciding which facilities to target and how.

A Report on Accelerating Commercial Building Energy Retrofits

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leap — local energy alliance program

IMT — Institute for Market Transformation

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Section I: Sector Overview

Generally, the *Public Schools* market sector is distinguished from colleges, universities, and private schools. This distinction is based primarily on campus configuration and governance.[1] Although all are in the education business, public schools have a very different set of decision-makers, budgeting and procurement processes from university campuses, and usually different energy system designs. The approach to marketing energy and water efficiency and renewable energy to this market sector is therefore unique.

Subsectors:

Small grade schools and middle schools (K through 8 or 9):

- Key energy-related characteristics: small size, geographic separation, relatively simple HVAC systems
- Key decision-related characteristics: distinct school committees/boards, neighborhood involvement, energy decisions not made locally

Secondary and regional schools (grades 9 or 10 through 12):

- Key energy-related characteristics: Larger energy, water, and maintenance budgets make transaction costs affordable as a % of cash flow; campus configuration means larger central plants; larger and more complex systems of chilled water and hot water distribution; automated energy management systems more likely; significant numbers of air-handling units, pumps, fans, motors, cooling towers, roof-top units. generators, kitchen equipment, pools and auditoriums; thus more opportunities for efficiency interventions
- Key decision-related characteristics: larger on-site maintenance staff; closer to central budget and legal authorities; potential to engage faculty and students

Section II: Energy Efficiency in Public Schools

<u>Typical energy efficiency measures applicable to school buildings</u>

Small grade schools and middle schools (K through 8 or 9):

- Envelope measures: insulation; sealing of infiltration (but with regard to code-level air changes per hour in facilities without air conditioning or forced ventilation); window film on south-facing glass; air conditioning upgrades (where present); window and door repairs
- Lighting upgrades: occupancy sensors and schedule controls; LED replacements (LEDs are now cost-effective and provide good quantity and quality of lighting in most applications); daylighting improvements

[1] The distinctions made in this paper are generally important in making marketing, investment, and policy decisions. There will always be exceptions.

- HVAC: efficiency upgrades to boilers, air conditioners, heat pumps, fans and drives (where they exist); filter replacements, other preventive maintenance; thermostatic control upgrades, local valves; domestic hot water (DHW) temperature control, heating and distribution efficiencies, solar hot water
- Fuel conversions and billing reviews where better alternatives exist
- Water conservation: low-flow toilets, updated urinals; valve repair/replacement; leak repairs
- Capital improvements, repairs, and deferred-maintenance catch-up, wholly or partially repaid by energy and water savings (usually HVAC, windows, and roofs)
- Cafeteria/kitchen appliance upgrades
- Computer, vending-machine, and other plug-load controls
- Environmental remediation (waste stream, groundwater contamination, asbestos, etc.)

Secondary and regional schools

- All of above
- Central energy management systems, conversion to DDC
- Continuous commissioning, "energy watchperson" services
- Tune-up of RTUs, AHUs, split systems, cooling towers, other HVAC equipment
- Conversions to central HVAC with improved distribution; OR installation of point-of-use and seasonal heaters/boilers
- Cogeneration where year-round heat uses
- Economizers, variable-air-volume systems
- Efficient motors and drives
- Renewable energy installations: PV, solar thermal, geothermal heat pumps
- Aggregated sale of attributes into forward capacity and carbon markets
- Swimming pool covers, heating, ventilation and humidity controls
- Green roofs, waste water and runoff controls
- Ice or chilled-water storage

All schools, non-capital items

- Training, documentation, maintenance/service contracts
- Curriculum advice, student/staff involvement

<u>Typical benefits of energy efficiency</u>

Financial

- Private capital for new/improved energy- and water-using systems
- Reduced energy expense
- Reduced maintenance expense
- Reduced and postponed capital replacement costs
- Reduced water and sewer charges

Environmental

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- Reduced carbon emissions
- Reduced waste stream
- Remediation of any environmental hazards
- Water and wastewater conservation

Educational
- Improved learning efficiency, from comfort, healthy air and light
- Students participation, curricular enhancements
- Teachers and staff training, career development
- Parents and community learning and motivation

Health, Comfort, Safety, Reliability
- Improved indoor air quality, reduced contaminants
- Improved temperature control, air changes, light
- Safer nighttime and security lighting
- Fewer problems and complaints
- Dependable equipment and controls

<u>Barriers to implementation</u>

Financial
- Capital is short and other priorities dominate
- Energy and water budgets are small, savings potential does not get attention

Technical
- Although not "high tech," many efficiency improvements are complex by normal maintenance standards, and require specialized contractors
- The state of the art in energy efficiency is not widely understood by decision-makers
- The measurement and verification of actual savings is well developed but not easily communicated or visibly metered

Awareness, understanding, bias, communication
- Many decision-makers distrust the reality of "savings" and the promises of contractors
- Energy-efficiency decisions are complex and their engagement a "hassle"
- Despite national publicity, local understanding of the risks and rewards is cloudy
- Conservation is often associated with deprivation or government intrusion; targets and requirements can be resented
- Trusted, unbiased, and informed advisors are scarce

Decision-making
- Complex bureaucratic structures avoid risks, impose delays, inject political interests, impede procurement

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- Individual decision-maker incentives are not aligned with interests of students, staff, organizational economics, and environment
- Large numbers of stakeholders, any of whom can say "no"; but all must say "yes" simultaneously
- Environmental and efficiency policies are weak, imprecise, or not enforced

Section III: Case Studies

There are many specific case studies posted on the web sites of the Energy Services Coalition (http://www.energyservicescoalition.org/resources/casestudies), the National Association of Energy Services Companies (http://www.naesco.org/resources/casestudies), and the leading ESCOs. In addition, the Lawrence Berkeley National Laboratory has conducted exhaustive studies of the ESCO industry every few years for twenty years. LBNL and NAESCO maintain an ongoing database of industry practices, market trends, and results of projects (now into the thousands).

Additional case studies and analyses of project results are published in The *Energy Service Company (ESCO) Project Performance Benchmarking Fact Sheets* prepared by LBNL, U.S. DOE, and NAESCO staff (July 2011), prepared with EECBG and SEP funds under ARRA.

For case studies not based on ESCO experience, see EPA's "Energy Efficiency in k-12 Schools" guide (www.epa.gov/statelocalclimate/documents/pdf/k-12_guide).

The case studies, and the experience of the authors, show without exception the economic argument for energy efficiency investments in the target market sectors. That is, proven savings exceed debt service in virtually every case; and many facility improvements can be financed by including them in the package of e.e. measures.

Case Study Findings

Baseline conditions and motivation to act:

Those in charge of operating, maintaining, repairing, expanding, and budgeting for school facilities recognize their need for repairs and funding but do not easily see a way to monetize energy and water savings to meet their needs. The value proposition brought by ESCOs provides motivations aimed at the individual decision-makers' wishes and concerns: improved comfort, health and safety, reliability, control, educational support, environmental stewardship, reduced expense, and private capital for improvements. (See the elaboration of "Benefits" above.)

Almost every public school has opportunities for increasing efficiency while improving its facilities, at costs below savings. Most have great unmet needs for repairs and upgrades. That they do not act is neither a matter of opportunity nor of need, but of inertia. If every schoolhouse were a sole proprietorship and every contractor competent and honest, the only barrier would ironically be education. But the decision-makers and stakeholders are many, their motivations varied, their ability to benefit from savings limited, and the offers they see suspicious.

Business case for energy efficiency:

The primary business argument is the opportunity to obtain important equipment, advice, and repairs with no capital outlay and without operating budget impact, using the guarantees and private capital brought by ESCOs and other general contractors. The "savings" primarily go to retiring the contractors' debt, so are not realized (except for small shares) until the repayment term is over (typically 10-15 years). To make the private investment attractive, and thus secure good terms and competitive offers, requires aggregating a sufficient number of facilities to keep the transaction costs well under the profit margins. Contract terms can be complex, but there is substantial industry experience among independent energy consultants to make them transparent and competitive.

Programs and policies leveraged:

Every dollar of public funds, whether from local capital budgets or outside grants, can be "leveraged" by a factor of three or four by attracting private capital to expand the project. Environmental goals, targets, codes, benchmarking, executive orders, and other expressions of public policy are also "leveraged," by bringing that capital to bear on energy-efficient building improvements. Both forms of leverage are achieved when energy, water, and maintenance savings are applied to finance facility improvements as described in the Business Case above. Urgent repairs and deferred maintenance can thus be addressed beyond the capacity of the available school budgets.

Contractor selection and type of contractor:

Successful experience in the industry follows almost invariably a model of engaging an "energy general contractor" (GC) to analyze the facility, recommend improvements that can be amortized by savings, arrange or provide the financing, and engage subcontractors for detailed design, installation, commissioning, training, and documentation. Often the GC will provide some of these services with its own staff. If a guarantee of savings is desired, the GC will be an ESCO. (Some school systems will appoint on-staff managers or a consultant to handle the GC functions, but experience in the case studies indicates that it is difficult to take on that responsibility on top of other duties, and to produce the same savings and investment as the specialists do.)

Most large school districts can obtain good competitive bids from ESCOs and other GCs by aggregating their facilities and facilitating the contracting process. Often a trusted e.e. advisor will be retained to manage this process, review designs and installations, verify the GC's measurement of savings, and otherwise represent the facility managers.

Many trades are likely to be represented among the subcontractors, including the various branches of mechanical, electrical, plumbing, and controls contractors as well as specialists in building envelope integrity.

Financing and revenue options:

School districts, their counties or municipalities, and state educational finance authorities have bonding capabilities, but not necessarily capacities, within their debt ceilings. From time to time they will have federal, state, or foundation grants to cover efficiency-related improvements. More often they will need private capital to supplement their capital budgets.

Wherever there are significant e.e. opportunities (usually the case), the best access route is to monetize future savings. This creates a legitimate cash flow (well established by the case studies) that the public school can dedicate to repayment of private debt. Although few conventional lenders will consider that cash flow in their underwriting criteria, ESCOs can either provide or arrange capital sources accustomed to that form of "paper." They can usually craft an agreement that allows the school to incur a conditional form of obligation (paid only out of savings) that will not count against their debt limits—similar to a lease.

Once aggregated, school districts or other groups of public schools can solicit proposals from energy service companies and financing firms for the privilege of investing in these facilities. This is an attractive proposition because the aggregation (and management of the process) controls the transaction costs incurred by the ESCOs/investors. The investments pay for themselves out of energy and maintenance/replacement savings, and the ESCOs will guarantee that.

Beyond the savings, which exceed debt service, the energy-efficiency improvements throw off attributes such as peak-hour electric demand reductions and carbon dioxide emission reductions. These attributes are tradable commodities in established markets; and although such markets cannot be efficiently accessed by individual schools, they can be sold into by experienced aggregators. For peak-demand reductions, PJM runs a forward capacity market. For carbon reductions, markets include brokers such as the Bonneville Environmental Foundation, and local commercial and institutional organizations who value the offset of their own carbon emissions. (Universities, real estate companies, institutions, manufacturers and others now purchase such offsets regularly, and would be much more likely to pay substantial prices for those generated by energy-efficiency improvements in their own community.)

Timetable:

Typically, the opportunities for energy, water, and maintenance savings, and their optimum application to facility improvements, can be identified and described in a few months, once approvals are given and data on past consumption provided. Design detailing, equipment procurement, engagement of subcontractors, and installation can take as little as a few months for common replacements to a year or more for complex new systems and renovations. Commissioning of the work, documentation, and training of staff will add one to three months. On-going maintenance contracts may extend for many years beyond the project completion.

Costs:
The total cost of installing energy-efficient measures like those listed above ("Typical Energy Efficiency Measures"), together with their associated facility improvements, can vary widely and cannot be predicted without detailed analysis of the facilities and their energy use. An approximation can be made, however, by reference to national and regional data on the average energy intensity in public schools and the average savings and costs incurred. Nationally, K-12 public schools consume an average of about 70,000 Btu per square foot per year (EPA: Energy Star); the Virginia consumption is somewhat higher because of its higher ratio of electric to thermal energy use compared to northern schools. If the local weighted-average cost of fuel and electricity is, for example, 3 cents per thousand Btu, the annual energy cost can be expected to be around $3/sq.ft. The case studies show that 20% of energy can be saved with a simple payback of around 5 years, meaning that an investment of $3 per square foot will be generally financeable and will pay for itself out of future savings.[2]

Energy efficiency benefits:
See "Typical Benefits of Energy Efficiency" in Section 2.

Savings:
The analysis under "Costs" above shows that savings of around 60 cents per square foot of conditioned space can be achieved by financeable energy-efficiency improvements.

Section IV: Conclusions and Recommendations

Lessons and best-practices
Substantial energy-saving and water-saving opportunities exist in most school facilities, on the order of 60 cents per square foot per year saved for an investment on the order of $3/sq.ft.[3] That 5-year simple payback supports most forms of financing, because the savings easily exceed debt service. Although schools' access to conventional financing is limited by debt ceilings and many political and processing barriers, a robust industry of private investors is prepared to advance funding to those schools that can execute binding contracts. Some such contracts avoid the schools' financing limitations, notably performance contracts offered by the ESCO industry (which include some form of savings guarantee).

An important lesson is that energy and water savings support investments not only in the measures that produce them, but in related facility improvements that can include essential repairs, catching up on deferred maintenance, increasing comfort and the learning environment, improving reliability, safety, and other benefits.

[2] The many variables involved in this simple example mean that actual costs in any given school could be less than half or more than twice as much

[3] These are energy-savings averages. Water savings add to the totals, but for schools is not usually a substantial part of the opportunity. This may change as water, wastewater, and stormwater disposal costs increase.

Marketing to public schools is most effective when focused on such benefits, on the personal needs and concerns of individual decision-makers, and with recognition of the difference between the subsectors described above.

Best practices supported by schools' experience nationally include contracting with an ESCO selected competitively. ESCOs provide expert identification of savings opportunities, general contracting (including selection and supervision of specialized subcontractors), commissioning, documentation, training, and maintenance support. A related Best Practice is to engage an independent engineer and "owner's agent" to represent the school in selecting ESCOs, negotiating contracts, overseeing the work and its commissioning, verifying savings, and otherwise ensuring the schools' interests are protected.

An excellent "do it yourself" guide ("e.e. Programs in k-12 Schools") is published on line by U.S. EPA (www.epa.gov/statelocalclimate/documents/pdf/k-12_guide). The Best Practices in that guide start with how schools can organize their efforts, and discuss engaging stakeholders, financing options, government programs, and case studies. They are aimed at local administrators who are in a position to manage their own programs without relying on ESCOs.

Program and policy recommendations

General Policy recommendations are given in the Task 1 report.

For schools, the first policy decision is whether the governing agencies have the ability to organize a complex program, convene the key stakeholders, handle procurement and technical project management, secure financing, and make technical and financial decisions efficiently. If so, the governing agency should consider following the EPA Guide described above. If not, the fastest and least expensive process is to engage an experienced technical assistance advisor to support the stakeholders in these tasks, and to lead a procurement and oversight of ESCO(s).

<u>Bibliography</u>

The most up-to-date references are on line. Some are cited throughout this paper in the appropriate sections. Several pages of references are cited at the end of the EPA Guide described above.

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